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**PATENT SPECIFICATION**

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**COMPLETE SPECIFICATION**

**Improvements in Apparatus for Delivering Mists or Aerosols for Breathing Purposes**

I, PIERRE LOUIS ANDRE VERGNE, a Citizen of the French Republic, of 19, rue du Calvaire, Saint-Cloud (Seine & Oise), France, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to apparatus for delivering mists or aerosols, that is to say, very fine liquid particles in suspension in a gas, for breathing purposes by a patient or other user.

It is chiefly intended to permit a better delivery of the mists to be supplied.

According to my invention, while producing in such apparatus a mist or aerosol by very finely atomizing a liquid in a gas and in particular in air, I provide said apparatus with means capable of stopping this atomizing outside of the periods of inhalation of the patient or other user. The said means may include a valve, operatively connected with a diaphragm responsive to the reduced pressure effects produced by the inhalation of the patient, which valve thus cuts off, outside of the periods of inhalation, the inflow of liquid or gas toward the atomizing device.

In the casing of the apparatus a through-passage may be provided terminating at one end in an inlet device for air entering the casing in addition to the atomising gas, and at its other end in a nozzle or outlet piece for connection to the face mask, and said air inlet device and said nozzle may be adapted to be easily removed in such a manner as to permit of easily disinfecting said casing.

The reduced pressure effects may be produced by the user in a space disposed laterally within the casing and in communication with the through-passage.

The atomizing nozzles or jets of the apparatus may be mounted on a supporting block fixed in a removable manner to the apparatus casing so as to permit easy

removal and cleaning of said jets.

Preferred embodiments of my invention will be hereinafter described with reference to the accompanying drawings, given merely by way of example and in which:—

Figs. 1 and 2 are sectional views, respectively on the line I—I of Fig. 2 and II—II of Fig. 1, of an apparatus for delivering aerosols, made according to my invention.

The apparatus includes a mist-delivering block or aerosol generator proper made in any suitable usual manner, for instance as shown by Fig. 1. According to this embodiment, I atomize at least one liquid 1 contained in a reservoir 2 into which dips a tube 3 provided at its end with a nozzle 4.

At right angles to the axis of this nozzle, I provide the outlet 5 of a compressed gas (usually compressed air) feed 70 conduit, coming for instance from a reservoir or a compressor fixed to the apparatus. Opposite outlet 5, there is a deflector 7, adjustable by means of a knob 8, and which permits of modifying the composition of the aerosol obtained. The patient directly breathes, through a mask connected to outlet tube or nozzle 9, the aerosol thus obtained. Liquid 1 ascends through tube 3 when compressed air flows past jet 4, thus producing opposite said jet a suction which draws out said liquid. A valve 10, subjected to the action of a weak spring 11, permits the inflow of additional fresh air into the apparatus. As for the expired gases, they are evacuated, preferably without entering the apparatus, through a valve provided in the breathing mask (not shown), whereas another valve, working in a direction opposed to that of the preceding one, prevents said expired gases from entering the apparatus.

It is known that the three periods of a breathing movement, namely, inhalation or inspiration, expiration and rest, are

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approximately of the same respective durations. It follows that if an aerosol is made to work only during the periods of inspiration of the patient, it will be possible to obtain a considerable saving in the amounts of air and liquid that are delivered, and further to obtain a much more regular rating of the amounts absorbed by the patient in the course of 10 inspiration.

For this purpose, according to my invention, I provide the apparatus with means for stopping atomizing outside of the periods of inspiration of the patient,

15 these means consisting in particular in at least one valve or the like, operatively connected with a diaphragm responsive to the effects of the suction produced by inspiration, which valve is capable of cutting off, outside of the periods of inspiration, the inflow of liquid or gas toward the atomizing device.

In the embodiment which is being described by way of example, I act only on 20 the compressed air inflow, which seems most advantageous; but it goes without saying that I might, in other embodiments, act also, or only, on the liquid conduit 3.

25 The connection between the diaphragm responsive to suction and the cut off valve can be made in any suitable manner, but it seems particularly advantageous to proceed, for this purpose, as shown by Fig. 2.

30 Diaphragm 12, made of a flexible material, is shown in this figure. This diaphragm separates two spaces, namely space 14, in communication with the atmosphere through orifice 15, and space 40 16, in communication with a conduit or through-passage 23 in the aerosol generator proper, through conduit 17.

35 Diaphragm 12 is deformed when inspiration takes place and transmits its movement, through the intermediate of a lever 18, to a valve 19 disposed across the compressed air conduit 20—21 and subjected to the action of a spring 22.

40 It will be understood that, under these conditions, the suction that is produced in the apparatus by an inspiration of the patient, may be capable of opening valve 19. Of course, such an effect is possible 45 only if the adjustment of the additional air valve 10 permits of obtaining and keeping in the apparatus a suction sufficient for causing diaphragm 12 to operate and for lifting said valve, which can

50 easily be obtained when adjusting the apparatus for the normal conditions of use.

55 However, means for directly acting upon diaphragm 12 should be provided, for instance in order to enable an opera-

tor to test the operation of the apparatus, or in order to control it in continuous working conditions, for instance when the inspirations of the patient are insufficient for actuating by themselves said diaphragm (case of a child for instance). I may, for this purpose, provide, adjacent diaphragm 12, a push-button 13a or the like, normally kept out of action on this diaphragm by a spring 13b, but which may be applied against said diaphragm, in the position of operation of the apparatus, by a bolt 13c.

60 Into the through passage 23 in the casing of the aerosol generator open the liquid jet and the conduit of gas under pressure, and also the conduit 17 which connects the preceding one with suction space 16, and the ends of this conduit 23 (which is, on the other hand, advantageously given a shape including two substantially rectilinear and parallel portions, as shown by Fig. 1) are closed by 65 easily removable plugs or the like, for instance threaded plugs, these plugs being advantageously combined, one with the outlet piece or nozzle 9 of the apparatus, to be connected with a breathing mask or the like, and the other with the supplementary air inlet valve 10.

I may thus easily proceed to cleaning and disinfecting of the apparatus, even, if necessary, by heating thereof in an autoclave if said apparatus is made of a material capable of supporting this operation, which seems particularly advantageous.

According to another feature, the jets or nozzles of an aerosol generating apparatus are fitted on a supporting block 105 fixed in a removable manner to the apparatus. This permits easy removal and cleaning of said jets or nozzles.

Concerning the shape to be given to the supporting block, it would be such as to permit connection of the compressed gas conduits 6 and 20. For this purpose, it seems advantageous to give said supporting block a shape similar to that shown by Fig. 1. This figure shows that supporting block 24, pushed by the threaded plug 25, includes two flanges 26 and 27 which ensure a fluidtight closing of the circular space 28 which serves to connect compressed air conduit 6 and 20.

110 Thus, it will suffice to unscrew plug 25 and to extract supporting block 24, to reach outlet 5 and jet 4 and to be able to clean them.

Such an aerosol generator has, in particular, the following advantages:—

115 Important saving in the consumption of liquid to be atomized and of compressed air or gas;

Higher regularity of the proportions sucked in by a patient;

Great simplicity of cleaning, which involves a satisfactory working of the apparatus, in good hygienic conditions.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim

10 is:—

1. An apparatus for delivering mists or aerosols, for breathing purposes by a patient or other user, including a device for atomizing a liquid in a gas, in particular in air, characterized by the provision of means for stopping the operation of said atomizing device when the patient or other user is not inhaling.

2. An apparatus according to claim 1, further characterized in that the said means include a valve, operatively connected with a diaphragm responsive to the reduced pressure effects of the breathing of the patient or other user, to 25 cut off the inflow of said liquid or gas during the periods for which the user is not inhaling.

3. An apparatus according to either preceding claim, and comprising a casing, characterized by the provision in

said casing of a through-passage terminating at one end in an inlet device for air entering the casing in addition to the atomizing gas, and at its other end in a nozzle or outlet piece for connection to a 35 face mask.

4. An apparatus according to claims 2 and 3, characterized by the fact that the reduced pressure effects are produced by the user in a space disposed laterally in 40 the casing and in communication with the through-passage.

5. An apparatus according to Claim 3, having atomizing nozzles or jets, characterized by the fact that said nozzles or 45 jets are mounted on a supporting block fixed in a removable manner to the apparatus casing so as to permit easy removal and cleaning of said jets.

6. An apparatus for delivering mists or 50 aerosols for breathing purposes by a patient or other user, substantially as described herein with reference to the accompanying drawings.

Dated this 26th day of October, 1949.

For the Applicant:  
F. J. CLEVELAND & COMPANY,  
Chartered Patent Agents,  
29, Southampton Buildings,  
Chancery Lane, London, W.C.2.

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